

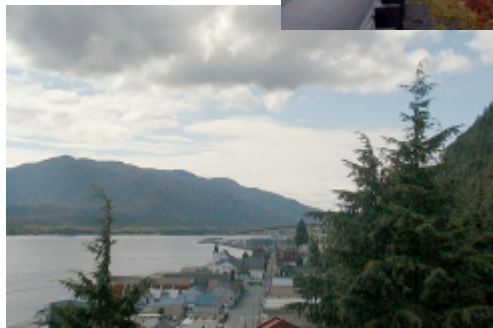
# Gravina Access Project Alternatives Evaluation Summary Report *Draft*

Agreement 36893013  
DOT&PF Project 67698  
Federal Project ACHP-0922(5)

Prepared for:  
State of Alaska  
Department of Transportation  
and Public Facilities



6860 Glacier Highway  
Juneau, AK 99801



Prepared by:  
HDR Alaska, Inc.  
712 West 12th Street  
Juneau, AK 99801

January 2002

# **Gravina Access Project**

## ***Alternatives Evaluation***

## ***Summary Report***

***Draft***



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## **1.0 Introduction**

The Alaska Department of Transportation and Public Facilities (DOT&PF) is currently considering eight build alternatives for the Gravina Access Project. HDR Alaska, Inc. (HDR) and its affiliates have conducted technical investigations for the DOT&PF to refine the engineering of the alternatives and evaluate the potential impacts associated with each alternative. This report presents the results of the engineering and environmental evaluations of the Gravina Access Project alternatives conducted to date.

### **1.1 Project Background**

The Gravina Access Project is a high priority project authorized by the Transportation Equity Act of the 21<sup>st</sup> Century (TEA-21), which allocated approximately \$20 million toward “constructing a bridge joining the Island of Gravina to the Community of Ketchikan on Revilla Island.” Figure 1 shows the location of the Gravina Access Project area. The DOT&PF contracted with HDR Alaska, Inc. in 1999 to conduct engineering and environmental studies of the project area and develop and investigate options for improved access between Revillagigedo and Gravina islands.

In Spring 2000, the project team developed 18 alternative concepts for crossing Tongass Narrows. These included multiple types of bridges, ferry connections that would augment the existing airport ferry service, and underwater tunnels. A screening process, based on input from federal, state, and local agencies, was used to evaluate these options and help identify the reasonable alternatives that should be studied in greater detail. After carefully considering the results of the screening process and input from the Ketchikan community, the DOT&PF selected seven alternatives as reasonable alternatives for the Gravina Access Project. The state and federal agencies involved in the environmental review process approved these seven alternatives for further review and analysis. Engineering studies conducted in Spring 2001 led to some refinements of the alternatives and the addition of a new alternative, for a total of eight reasonable build alternatives. (See Section 2.0 *Description of Alternatives*.) The eight reasonable build alternatives for the Gravina Access Project are shown in Figure 2.

During Summer and Fall 2001, the project team conducted detailed engineering and environmental studies of the eight build alternatives to further refine the design and engineering requirements of the alternatives and to characterize the potential environmental impacts that might result from construction and long-term use of the project. The results of these studies are presented in this document. With information obtained from these studies and input from the community, the DOT&PF will identify a preliminary preferred alternative for the Environmental Impact Statement. A Draft Environmental Impact Statement will be available to the public in Spring 2002.

### **1.2 Project Purpose and Need**

The purpose of the Gravina Access Project is to improve surface transportation between Revillagigedo Island and Gravina Island. The need for improving access is three-fold:

- *To improve the convenience and reliability of access to Ketchikan International Airport for passengers, airport tenants, emergency personnel and equipment, and shipment of freight.*
- *To provide the Ketchikan Gateway Borough and its residents more reliable, efficient, convenient, and cost-effective access for vehicles, bicycles, and pedestrians to borough lands and other developable or recreation lands on Gravina Island in support of the borough's adopted land use plans.*
- *To promote environmentally sound, planned long-term economic development on Gravina Island.*

### **1.3 Purpose of this Document**

HDR conducted preliminary engineering studies to refine alignment locations, determine right-of-way and bridge structure requirements, revise preliminary quantities and cost estimates, and conduct navigation analyses. This report summarizes the engineering evaluation of the alternatives, including preliminary design information, assessment of navigational issues and aviation/airport issues, and the costs associated with each of the alternatives.

Based on information developed during the preliminary engineering studies, HDR assessed the potential impacts of the eight build alternatives and a no-action alternative on:

- Land use
- Social environment
- Economy and economic development
- Transportation
- Biological resources
- Water quality
- Wetlands
- Wildlife
- Water bodies
- Visual environment
- Energy and utilities
- Historic and archaeological preservation
- Hazardous waste sites

This report presents the primary findings of HDR's assessment of the potential impacts of the eight build alternatives and the no-action alternative on these resources. DOT&PF will carefully consider the information presented in this document when making its decision about which alternative to recommend to the Ketchikan community.

## 2.0 Description of Alternatives

Figures 3 through 9 depict the locations of the eight reasonable build alternatives for the Gravina Access Project. Table 1 provides a summary description of the project alternatives, including terminus locations, general alignment across Tongass Narrows, and bridge clearances and dimensions. All of the alternatives include a road on Gravina Island to connect the crossing terminus with both the airport terminal and the developable land at the northern end of the Airport Reserve property. Roadway construction immediately south of the airport runway would be designed to accommodate runway expansion as a bridge over the road.

**Table 1. Description of Project Alternatives**

Alternative and Mode	Bridge Vertical Clearance (VC), Horizontal Clearance (HC), Height (H), and Length (L)	Termini		General Alignment Across Tongass Narrows
		Revillagigedo Island ("Takeoff")	Gravina Island ("Touchdown")	
No-Action	N/A	Existing airport ferry terminal	Existing airport ferry, east of Airport	Existing (2.8 miles north of downtown)
C3(a) Bridge	VC = 200'; HC = 650' H = 250'; L = 0.9/1.0 mile	Signal Road	South of airport terminal	1,600' north of airport terminal
C3(b) Bridge	VC = 120'; HC = 500' H = 150'; L = 0.8 mile	Signal Road	At airport terminal	2,600' north of airport terminal
C4 Bridge	VC = 200'; HC = 650' H = 250'; L = 0.9/1.0 mile	Tongass Ave. north of Cambria Drive	South of airport terminal	1,600' north of airport terminal
D1 Bridge	VC = 120'; HC = 500' H = 150'; L = 0.6 mile	Tongass Ave. near airport ferry	At airport terminal	Due east of airport terminal
F3 Bridges	<u>East Channel:</u> VC = 60' ; HC = 500' H = 100'; L = 0.4 mile <u>West Channel:</u> VC = 200'; HC = 650' H = 250'; L = 0.5/0.6 mile	Tongass Ave. south of U.S. Coast Guard base and north of Forest Park Subdivision	South of airport	<u>East Channel:</u> 1.1 miles south of downtown <u>West Channel:</u> 3.2 miles south of airport terminal
G2 Ferry	N/A	Peninsula Point	Lewis Point	2.1 miles north of airport
G3 Ferry	N/A	Downtown, near Plaza Mall	South of airport	0.9 miles south of airport
G4 Ferry	N/A	Adjacent to existing ferry terminal	Adjacent to existing ferry terminal	2.8 miles north of downtown

Source: Reference 1.

## 3.0 Engineering Evaluation of Alternatives

### 3.1 Preliminary Engineering

Preliminary engineering studies involved refinement of the alternatives' design information, including right-of-way requirements, alignments, verification of elevations, cut and fill requirements, typical roadway cross section, bridge types, and ferry terminal layout in accordance with the design criteria (References 2-5). The following sections summarize the preliminary engineering studies.

#### 3.1.1 Engineering Criteria

Engineering criteria used to evaluate the initial set of options included considerations of the navigation clearance requirements, aviation clearance requirements, roadway design criteria in accordance with the DOT&PF Highway Preconstruction Manual, AASHTO requirements for road and bridge construction, and sound engineering judgment.

The design criteria (Reference 5) used to evaluate the eight build alternatives include the following:

- Minimize intrusion into Federal Aviation Regulations (FAR) Part 77 airspace surface for Ketchikan International Airport<sup>1</sup>.
- Avoid penetration of Ketchikan International Airport Object Free Area, Runway Safety Area, and approach surface portion of the Part 77 airspace surface, based on the airport layout plan.
- Provide reasonable navigation clearance in accordance with PIANC<sup>2</sup> conceptual guidelines for bridge openings and the results of a Monte Carlo simulation. These results have been interpreted for this project as either a 500 or a 650-foot horizontal clearance and 120 or 200-foot vertical clearance, depending on the alternative.
- Apply DOT&PF standards for roadway design and alignment criteria:
  - 6 percent maximum grade on structure, 8 percent elsewhere.
  - Bridge must have two 11.8-foot wide travel lanes and two 8.2-foot wide shoulders with a 7.9-foot wide sidewalk.
  - Off bridge roadway must have two 11.8-foot wide travel lanes and two 7.9-foot wide combination shoulder/bike path/pedestrian walkway.
  - Design speed of 43.5 miles per hour.
- New ferries are based on the new ferry recently built to serve Ketchikan International Airport.

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<sup>1</sup> Part 77 of the FAR, Objects Affecting Navigable Airspace, was developed to control the height of objects in the vicinity of an airport to ensure that airspace and approaches to runways are protected from encroachment hazards that could affect the safe and efficient operation of the airport. The Part 77 airspace plan for Ketchikan International Airport was investigated (*Gravina Access Project Tongass Narrows Aviation Conditions Summary*; HDR, October 1999) and alternatives were developed that would minimize impacts on the airport's Part 77 surfaces.

<sup>2</sup> International Navigation Association

Bridge concepts were based on a preliminary evaluation of multiple types of bridges: moveable, floating, and fixed spans using concrete and steel. Cable stay and arch bridges were also evaluated. Primary evaluation factors used in determining the recommended bridge type were:

- Proven Bridge Type/Mature Technology
- Aviation Impacts
- Environmental Impacts
- Constructibility
- Cost to Build
- Cost to Maintain
- Use of Local Materials

Based on the bridge type evaluation (Reference 3), the alternative bridge type appropriate for all current bridge alternatives for the Gravina Access Project is a concrete box girder bridge. This bridge type has been proven for this type of crossing up to a main span of 850 feet. This bridge type also requires the least amount of annual maintenance and, aesthetically, has clean simple lines. Local materials (aggregate) can be used for its construction. This bridge type was used to develop conceptual costs for all bridge alternatives for comparative purposes.

### 3.1.2 Engineering Comparison

Based upon the preliminary engineering completed for the build alternatives, the following comparisons are presented:

**Table 2. Comparison of Project Alternatives**

Alternative	New Roadway length (feet)	Travel time to Airport (minutes)	Intrusion into Airport Clearance Zones	Navigation Openings Width/Height (feet)	Total Structure Length (feet)	Meet DOT&PF Criteria
C3(a) – 200ft	20,709	14	Yes	650/200	1,736	Yes
C3(b) – 120ft	21,453	12	No	500/120	1,296	Yes
C4 – 200ft	20,630	11	Yes	650/200	1,519	Yes
D1 – 120ft	19,193	11	No	500/120	981	Yes
F3 – 200ft	36,837	12	No	650/200	1,654	Yes
G2	30,407	40	No	N/A	N/A	Yes
G3	23,189	33	No	N/A	N/A	Yes
G4	17,858	25	No	N/A	N/A	Yes

### 3.2 Navigational Issues

Navigational issues in Tongass Narrows were assessed through an inventory of marine traffic types and volumes, weather conditions and currents, existing physical constraints to navigation, and floatplane operations. Projections of future cruise ship traffic in Tongass Narrows were included in the assessment. Marine pilots were interviewed for additional input on the effects of the alternatives on marine navigation. Navigational issues are primarily related to the bridge alternatives for the Gravina Access Project.

In developing bridge alternatives for the project, a vertical clearance of 200 feet (Alternatives C3[a], C4, and F3) was determined to provide sufficient navigational clearance for ships calling at Ketchikan because it would equal the vertical clearance of the Lions Gate Bridge at the First Narrows at Vancouver, British Columbia, under which nearly all of the large cruise ships (i.e., the tallest ships) calling at Ketchikan pass. In the case of Alternative F3, however, the 200-foot vertical clearance would only be provided at the West Channel crossing, and the East Channel (currently the primary navigational route around Pennock Island) would be blocked to ships requiring vertical clearance greater than 60 feet. Although Alternative F3 would provide sufficient navigational clearance for taller ships calling at Ketchikan, passage through the West Channel would make cruise ship operations more complicated. Alternatives C4 and D1 would block passage of ships requiring a vertical clearance greater than 120 feet, requiring large cruise ships to enter and depart Ketchikan from the south. This would add distance to existing operational routes: the typical increase in route distance would be approximately 30 nautical miles for northbound ships.

Initial estimates of the navigation channel width (distance between bridge piers) were developed using the PIANC (International Navigation Association) concept design method. Based on an historical survey of ships that have passed through Tongass Narrows, projections of the type of ships anticipated to use the channel in the future, factors for channel bottom type and depth, visibility, and type of channel navigational aids, a concept design horizontal clearance of 550 feet was selected for bridges with sufficient vertical clearance to permit large cruise ship passage. Similar estimates for Alaska Marine Highway System ferries resulted in a 500-foot horizontal clearance for the concept designs of bridges with vertical clearance sufficient for Alaska ferries<sup>3</sup>.

Computer simulations of a series of ship passages through Tongass Narrows were also initiated to develop a risk profile for ship passage. Called Monte Carlo simulations, the analysis is a means to assess the theoretical risk of a large cruise ship grounding in Tongass Narrows. Use of the Monte Carlo simulation for the Gravina Access Project is consistent with the request made by the U.S. Coast Guard Office of Bridge Administration to apply modern simulation methods to determine the horizontal clearance for any bridge crossing Tongass Narrows. It is also consistent with PIANC recommendations to use fast-time simulator techniques during preliminary design to estimate horizontal clearances.

In the Monte Carlo fast-time maneuvering simulations conducted for the Gravina Access Project (Reference 6), the risk of groundings or allisions has been determined for the natural channels at Charcoal Point, East Channel, and West Channel, and for large cruise ships and Alaska ferries transiting Tongass Narrows under the project's alternative bridge sites. The study estimated the probability distributions and statistics for 26,639 cruise ship transits and 45,550 Alaska ferry transits over 50 years. The Monte Carlo study primarily confirms the need for pier protection for bridge alternatives. Secondly, the study assesses the theoretical risk associated with current operations in Tongass Narrows to gauge the risk associated with proposed new bridges. According to the Monte Carlo study, it would require a bridge at Alternative C3(a) or Alternative C4 with an effective horizontal clearance of 687 feet to equal the passage risk near Charcoal

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<sup>3</sup> Gravina Access Project Reconnaissance of Vessel Navigation Requirements Updated Report. October 2001. Prepared for Alaska DOT&PF by The Glosten Associates, Inc.

Point, but a bridge at that location with a 550 foot horizontal clearance would present less than half of the relative risk associated with the current passage of East Channel.

The U.S. Coast Guard is responsible for establishing navigation requirements, with the ultimate criterion being to meet the reasonable needs of navigation. The U.S. Coast Guard has stated that it must establish bridge clearances of navigable waterways in consideration of available studies, computer simulations, real time simulations, and consultation with the U.S. Army Corps of Engineers, the Federal Highway Administration, the design team, marine pilots, and shipping interests. The U.S. Coast Guard will provide the minimum navigational clearances needed for a bridge alternative, which may result in adjustments to the horizontal and vertical navigational openings used in this evaluation.

### **3.3 Aviation/Airport Issues**

#### ***3.3.1 Effects on Air Space***

HDR conducted an analysis of the air traffic impacts in the Ketchikan airspace resulting from the bridge alternatives under consideration for the Gravina Access Project (Reference 7). The assumption underlying this analysis is that Special Visual Flight Rules (SVFR) operations in the Ketchikan Class E airspace would be prohibited or the minimum altitude would be adjusted to provide adequate clearance between a bridge and aircraft. The approach and findings of the analysis are summarized below.

- Based on the percentage of forecast SVFR floatplane operations and the percentage of hours for SVFR conditions, it is expected that the impact from a bridge crossing of Tongass Narrows on SVFR aircraft operations will be increased delays to a small percentage of the overall operations as a result of a change in minimum SVFR altitudes or the exclusion of SVFR operations altogether.
- General Aviation and commercial pilots wishing to operate during SVFR conditions could expect to be delayed up to approximately 3 hours during mornings or evenings if SVFR operations are excluded or minimum altitudes are adjusted and time-sensitive departures would be eliminated.

#### ***3.3.2 Effects on the Airport and Float Plane Facilities and Operations***

HDR conducted an analysis of the direct and indirect effects of each of the Gravina Access Project alternatives on the current and planned airport development, floatplane facilities, and to airport and floatplane operations (Reference 8). The general conclusions are:

- All alternatives would result in increased parking demand and a parking structure would ultimately be required at the airport terminal area.
- The location of the piers for Alternatives C3(a)/(b) and C4 could hamper the ability of floatplane pilots to maneuver into and out of the Ketchikan International Airport floatplane base and transient dock at the current location and could require relocation of some of the floatplane parking ramps or slips.
- The bridges of Alternatives C3(a)/(b), C4, and D1 could affect floatplane landing and takeoff areas, particularly the takeoff and landing area associated with the floatplane base at the airport.

- Due to the proximity with the transient floatplane ramp, the ramp and dock would likely need to be relocated under Alternatives C3(a)/(b) and C4, at least during construction, and could require permanent relocation or realignment.
- Alternatives C3(a) and C4 each penetrate the imaginary surface of the airport's Part 77 airspace. The Federal Aviation Administration has not yet issued a final airspace determination.
- Alternative G3 would cross the Ketchikan Harbor Seaplane Float landing and takeoff area at its most northern end; Alternative G2 crosses the Ketchikan International Airport floatplane landing and takeoff area at its northwest end and the existing ferry and Alternative G4 crosses near its southeast end. Floatplane traffic would have to contend with additional ferry traffic traversing perpendicular to the floatplane operations at these locations.

### **3.4 Cost Considerations**

Cost estimates of the alternatives were prepared based on the preliminary engineering analysis (Reference 9). The cost estimates include both project development and life cycle costs.

#### **3.4.1 Construction Cost Estimates**

Construction quantities for the build alternatives were calculated based on the conceptual design for major items only, such as earthwork, surfacing/paving, structures superstructure based on square meter of deck area, substructure based on depth of water, and drainage way crossings. All other items are based on assumed lump sums, or percentage of the major items. Unit costs are based on available bids for similar types of projects, such as the Benicia Martinez bridge, the 3<sup>rd</sup> Avenue construction in Ketchikan, or the acquisition of the airport ferry in Ketchikan. Miscellaneous items have been estimated as 25 percent of all construction costs except the bridge. Mobilization costs are estimated as 10 percent.

Each element of construction has been assigned a contingency factor to acknowledge that lack of site-specific information affects the confidence of the cost estimate. For example, surfacing area can be easily calculated based on design criteria for roadway width and alignment location for roadway length, so the contingency applied to the surfacing area cost is a relatively low 2.5 percent. On the other hand, there is no available foundation information in the immediate vicinity of the bridge alignments, so a contingency of 25 percent is applied to foundation costs.

All alternatives include the cost of the crossing and access to the airport terminal area, as well as access to the developable lands north of the airport. In addition, the cost includes a parking garage near the terminal for 300 cars.

A summary of construction cost estimates is shown in Table 3.

**Table 3. Construction Cost Estimate Summary**

Alternative	Construction Cost Estimate (\$ million*)
C3(a) – 200ft	135
C3(b) – 120ft	125
C4 – 200ft	140
D1 – 120ft	90
F3 – 200ft	135
G2	45
G3	45
G4	40

\* Values are rounded to the nearest \$5 million

### 3.4.2 Program Development Costs

In addition to the construction costs, all build alternatives would have associated program development costs. All of these items are typically applied as percentages of the base construction costs, and are additive to that cost. In addition to the construction costs, the program development costs applied are as follows:

Miscellaneous Contingency	15 percent
Mitigation	2 percent
Engineering/Administration	8 percent
Construction Management	11 percent

Right-of-way acquisition is added as a program development cost. A summary of program development costs are presented in Table 4:

**Table 4. Program Development Costs Summary**

Alternative	Construction Cost Estimate (\$ million*)	Program Development Cost (\$ million*)	Total Cost Estimate (\$ million*)
C3(a) – 200ft	135	50	185
C3(b) – 120ft	125	50	175
C4 – 200ft	140	55	195
D1 – 120ft	90	35	125
F3 – 200ft	135	55	190
G2	45	20	65
G3	45	20	65
G4	40	20	60

\* Values are rounded to the nearest \$5 million

### 3.4.3 Life Cycle Costs

Life cycle costs were developed for all alternatives for comparison purposes. Life cycle cost analyses are often useful to evaluate the total cost of the project over its useful life, taking into consideration both program development costs as well as annual operation and maintenance costs, major rehabilitation required during the life of the project, and the cost of money. The life cycle cost for this project used guidelines provided in Federal Highway Administration—Office

of Management and Budget—Circular No. A-94, October 29, 1992, and subsequent appendices. The assumptions used in the analysis include:

- All pavements would have to be overlaid at 20-year intervals.
- Mechanical/electrical equipment of ferries would have to be replaced every 25 years.
- Ferry terminal maintenance would be required every 10 years.
- The useful life of a bridge is 75 years.
- The useful life of the parking structure is 75 years.
- The life of a ferry is 50 years.
- Long-term inflation is 2 percent.
- Long-term interest rate is 6.3 percent.

Annual costs of operation and maintenance were based on evaluation of comparable systems, such as the existing ferry system, or maintenance of large concrete bridges. Based on the assumptions, Table 5 provides a summary of the life cycle costs of the alternatives:

**Table 5. Life Cycle Costs Summary**

<b>Alternative</b>	<b>Annual Operation &amp; Maintenance Cost* (\$ million)</b>	<b>Total Life Cycle Cost (\$ million**)</b>
C3(a) – 200ft	0.18	155
C3(b) – 120ft	0.18	150
C4 – 200ft	0.18	170
D1 – 120ft	0.16	110
F3 – 200ft	0.27	160
G2	4.50	110
G3	4.49	105
G4	4.46	100

\* Includes annual operation and maintenance cost as well as annual contribution to fund periodic maintenance rehabilitation costs.

\*\* Values are rounded to the nearest \$5 million

## 4.0 Environmental Analysis of Alternatives

HDR completed its inventory of the environmental resources potentially affected by the Gravina Access Project in October 2000 (Reference 10). This inventory formed the basis for determining the potential impacts of the eight build alternatives.

### 4.1 Social Environment

The evaluation of the social environment addressed the following potential impacts:

- Growth and development of developable lands on Gravina Island (from improved accessibility and decreased travel times to the airport and developable land).
- Impacts on recreational opportunities (fishing, hunting, sightseeing, hiking, boating, and bicycling).
- Impacts on public services (schools, libraries, health facilities, and emergency response).
- Increased competition for subsistence resources (such as salmon, abalone, clams, deer, berries, and cedar bark).
- Changes in neighborhood character, cohesiveness, noise, and traffic.

- Acquisition of properties and/or relocation of residents and businesses (Reference 11).
- Disproportionate impacts on environmental justice (minority and low-income) populations.
- Adverse impacts on Section 4(f) land (public parks, refuges, and historic sites).

The specific impact categories listed above were evaluated in detail for each project alternative, as reported in the *Social Environment Technical Memorandum* (Reference 12). None of the build alternatives would substantially impact or significantly disrupt residential neighborhoods or business areas. All alternatives would result in growth and development on Gravina Island, which would lead to increased demand for public services. Improved access to Gravina Island under any build alternative would increase competition for subsistence resources on Gravina Island and, in the case of Alternative F3, on Pennock Island. None of the alternatives would have disproportionate impacts on environmental justice populations.

Alternatives C3(a)/(b), C4, and D1 would require relocation of some residences, which could diminish neighborhood cohesiveness. Alternatives C3(a)/(b), C4, D1, G2, and G3 would require acquisition of commercial property.

## 4.2 Economics

### 4.2.1 Economic Effects

This section summarizes the direct and indirect economic effects, which could arise from implementation of each of the proposed alternatives of the Gravina Access Project (Reference 13).

#### Direct Effects

Direct effects are those that are likely to be attributable to the selected alternative and which occur at the same time and place. These direct effects are grouped into three categories.

- (1) **Economic Effects of Relocations.** Each of the ferry alternatives would have some displacement effects due to the construction of new terminals. Alternative G2 will probably displace at least three structures at a floatplane maintenance facility, on Peninsula Point. Alternative G3 would involve the acquisition of one business (Burger King) and two other structures. No structures would be affected by acquisition of the land for Alternative G4. Each of the bridge alternatives is likely to have displacement impacts on residences or businesses. The acquisition of a residence and a business would be required with Alternative C3(a). The affected residence is on the east side of the North Tongass Highway and south of Hasting Street. The affected business, an auto dealer, is located near the intersection of Signal Road and the proposed new road associated with Alternative C3(a). If selected, Alternative C3(b) is expected to displace two residences on Bucey Avenue and the same business affected by C3(a). Alternative C4(a) is likely to require the acquisition of one residence on Tongass Avenue close to the intersection with Cambria Drive. Alternative D1 requires the acquisition of at least one structure on Tongass Avenue. However, the proposed right-of-way passes very close to a residence on Tongass Avenue and it may be necessary to purchase the residence as well. Both buildings are at the intersection of Tongass Avenue and Cambria Drive. Finally, it is anticipated that only one structure along the South Tongass Highway would be affected by the project right-of-way if Alternative F3 were selected.

The housing market in Ketchikan can readily absorb the few families that would be relocated and comparable housing could be found. It is anticipated that the businesses could be relocated and re-established with negligible long-term economic effect. The total amount of private property that would be taken for the project would range between 1.4 and 23.7 acres. Aside from the one to three developed parcels, the bulk of the private property is currently undeveloped and inaccessible and would experience no displacement of any existing economic uses.

- (2) **Construction Spending.** Over the construction phase of the selected alternative (excluding ‘no action’), it is estimated that between \$24 million (for a ferry alternatives) and \$83 to \$152 million would be added directly to the local economy through construction-related employment and local purchases of construction materials and equipment. These expenditures would generate additional local spending and government revenues as the recipients spend and save. These effects could raise local employment by more than 400 jobs in addition to those jobs created by local construction hiring. The estimates in Table 6 include the number of laborers directly involved in the construction activities, the number of persons employed in activities stimulated by inter-industry transaction, and the employment created by additional household and government spending.

**Table 6. Effects of Construction Activities on Employment by Alternative**

Alternatives	Employment (Total number of jobs) <sup>1</sup>		
	Construction Jobs	Other Jobs	Total Jobs
Bridge Alternatives			
C3(a)	841	394	1,235
C3(b)	860	405	1,265
C4(a)	965	451	1,416
D1	625	294	919
F3	900	420	1,320
Ferry Alternatives			
G2	231	111	342
G3	219	109	328
G4	177	84	261
No Build Alternative <sup>2</sup>	30	24	54

<sup>1</sup> Represents the total number of jobs created over the construction period. Annual employment estimates can be derived dividing total jobs by anticipated number of years in construction period.

<sup>2</sup> The older existing ferry will need to be replaced in 2015.

- (3) **Cruise Ship Operations.** Alternatives C3(b) and D1 have bridges with 120-foot vertical clearances and would require all large cruise ships making port calls in Ketchikan to approach from and depart to the south if no additional berthing facilities were built to the north of the bridge. This transit would add approximately 30 nautical miles to the route between Ketchikan and Juneau.<sup>4</sup> For some large cruise ships, the extra distance and time might reduce the port time spent in Ketchikan, or result in fewer port calls (Reference 14). Cruise ships could transit under Alternatives C3(a), C4, or F3 but Alternative F3 would require additional time for docking maneuvers which could also reduce port calls and port

<sup>4</sup> The Glosten Associates, Inc. fax to HDR Alaska, Inc. on Cruise Ship Operations, August 28, 2001.

time in Ketchikan (Reference 14).. The economic effects of these changes are considered indirect and are discussed below.

## Indirect Effects

Indirect impacts are those attributable to the selected alternative, which happen later or at a distance but which can be reasonably anticipated. There are two main categories of impacts that have been analyzed:

- (1) **Economic Effects of Changes in Cruise Ship Operations.** The potential direct economic impact of bridge Alternatives C3(b) or D1 could be a worst-case reduction in cruise ship-related spending of between \$3.1 million and \$22.1 million in the first year of operation.<sup>5</sup> Bridge Alternative F3 may also affect cruise ship operations by restricting travel to the West Channel of the Tongass Narrows, west of Pennock Island, which will require additional time for docking maneuvers. It is estimated that the reduction in cruise-related spending with Alternative F3 would be a worst-case reduction of between \$0.8 million and \$9.9 million in 2006. Alternative F3, as well as Alternatives C3(b) and D1 could also raise cruise ship operating costs through increased fuel consumption and additional tug assists.
- (2) **Regional Economic Development Impacts.** A bridge or improved ferry service would affect the nature of future development on Revillagigedo and Gravina islands. Table 7 shows several indicators of the level of economic development on Gravina and Pennock islands that might be achieved with a ferry alternative or a bridge alternative if there is a high level of economic activity in the region. The development and traffic forecasts (References 15 and 16) anticipate that the ferry alternatives would constrain development on Gravina Island. Table 7 compares the medium growth projection for Gravina Island, which is the maximum level of development anticipated with a ferry alternative, with the high growth projection that is achievable with a bridge alternative. Some of the growth on Gravina and/or Pennock Island is anticipated to be a transfer of development that would have occurred on Revillagigedo Island.

**Table 7. Additional Net Development Achievable with Alternative Type,  
Given High Level of Regional Economic Activity**

Category	Additional Achievable Development	
	Ferry	Bridge
Land Use (Acres)		
Gravina Island	171	368
Pennock Island (F3 Only)	0	208
Total	171	576
Population <sup>1</sup>		
Gravina Island	295	690
Pennock Island (F3 Only)	0	328
Total	295	1,018

<sup>5</sup> Cruise lines had widely varying responses on the effect of additional distance and time on their operations, so analytical assumptions regarding the probability of reduced port calls or time in port have wide ranges as well.

<sup>6</sup> Ibid.

Category	Additional Achievable Development	
	Ferry	Bridge
Employment		
Gravina Island	196	744
Pennock Island (F3 Only)	0	350
Total	196	1,094

<sup>1</sup> Permanent, year-round residents; with a bridge alternative a large population is expected to have seasonal or second homes on Gravina Island.

## 4.3 Land Use

### 4.3.1 Consistency with Land Use Plans

All project build alternatives would foster development on Gravina Island by improving access. Existing planning documents of the Ketchikan Gateway Borough note the scarcity of developable land along Tongass Narrows on Revillagigedo Island and support land settlement and development on Gravina Island for commercial, industrial, and residential uses. The Gravina Access Project is generally consistent with the development elements of the Borough's land use plans (Reference 17). Although the Borough is currently updating its comprehensive plan as part of *Ketchikan 2020*, neither the Borough nor the City of Ketchikan anticipates making any substantial changes in planning goals.

### 4.3.2 Changes in Existing Land Use

All build alternatives have been designed to minimize both the cost of acquiring property for right-of-way and the disruption to the community, which minimizes the direct impacts on land use changes as well.

**Revillagigedo Island.** No project alignment would substantially change overall land use patterns on Revillagigedo Island. Alternatives F3 and G4 would not change any land use; the other alternatives would require acquisition of all or a portion of some properties. The maximum number of properties whose land use would be affected in whole or by each alternative is listed in the following table.

**Table 8. Estimated Maximum Number of Properties Whose Land Use Would Be Affected**

Alternative	Residential Properties	Commercial Properties
C3(a)	5	2
C3(b)	8	2
C4	1	1
D1	2	1
F3	0	0
G2	0	3
G3	0	2
G4	0	0

**Gravina Island.** The direct land use impacts on Gravina Island of all build alternatives are largely the same: all build alternatives include roadway development on land that is currently vacant/wilderness and land that is part of the existing airport property. Development within the airport property under any alternative would be compatible with airport land use plans. The

conversion of vacant/natural areas to transportation usage would affect a very small portion of the total acreage of vacant/natural land on Gravina Island.

**Pennock Island.** Alternative F3 is the only build alternative that would cross Pennock Island. Although Alternative F3 would not change land use on Pennock Island, it could provide access, which is not consistent with the Pennock and Gravina Islands *Neighborhood Plan* (1985). Construction could require specific approval through either amendment of the plan or a Borough-wide vote. However, the *Neighborhood Plan* may be legally subsidiary to the Borough's *Comprehensive Plan* (1996), which supports development, and the legal status of the *Neighborhood Plan* would need to be verified before proceeding with Alternative F3.

#### **4.4 Natural and Cultural Resources**

The investigation of impacts to natural resources focused on water resources, marine habitat, wetlands, major fish species, large mammals, and threatened and endangered species. The investigation of impacts to cultural resources focused on historic and archaeological sites, the visual environment, traffic, hazardous waste sites, and utilities. The results of these analyses are contained in the Draft Biology Report (Reference 18). The following sections summarize the findings of these analyses.

##### **4.4.1 Water Resources, Wetlands, and the Marine Environment**

All of the build alternatives would potentially have adverse impacts on Tongass Narrows and its tributaries as a result of in-water construction activities, accidental fuel spills, and runoff from new roadways. Water quality could be affected by runoff from the bridges (Alternatives C3[a], C3[b], C4, D1, and F3) or from the ferry terminals and ferry vessel emissions (Alternatives G2, G3, and G4). Of greatest concern are the potential impacts to:

- Lewis Cove – All build alternatives cross Airport Creek, which flows directly into Lewis Cove.
- Government Creek – Alternatives F3 and G3 cross Government Creek.
- Clam Cove – Alternative F3 traverses the Clam Cove watershed in which most runoff occurs in sheet flow toward Clam Cove rather than definitive channels and streams.

All alternatives would cross wetlands. Alternatives C3(a)/(b), C4, D1, G2, G3, and G4 would affect approximately 35 to 45 acres of wetlands. Alternative F3 would affect the greatest amount of wetlands, approximately 86 acres, because it requires the greatest amount of new roadway construction of all of the alternatives.

The marine environment would be adversely affected by bridge alternatives due to shading and pier placement. Runoff from the bridge structure could also affect the marine environment. The ferry alternatives would adversely affect intertidal areas as a result of ferry terminal structure placement and ferry vessel emissions and maintenance activities.

#### **4.4.2 Fish and Wildlife**

Impacts to fish and wildlife would occur under all of the build alternatives due to loss or disruption of habitat associated with new construction. Impacts to fish habitat would occur at marine and freshwater stream crossings. Alternatives C3(a)/(b) and C4 would have the greatest impact on Essential Fish Habitat, affecting 7.2 to 8.8 acres. Alternative D1 would affect 4.7 acres and Alternative F3 and the ferry alternatives would affect less than 2.6 acres. Wildlife habitat would be removed on Gravina Island to accommodate roadway construction; however, similar habitat in proximity to the roadway alignments is abundant and the overall impact to wildlife would be minor.

None of the alternatives would affect threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service. Under the jurisdiction of the National Marine Fisheries Service (NMFS), however, two endangered species, the humpback whale and Stellar sea lion, could be impacted in the project area. These species could be adversely affected by construction activities and associated noise under any alternative. Further consultation with NMFS will be required as the project moves forward.

#### **4.4.3 Cultural Resources**

Historic and archaeological sites could be disturbed as a result of construction activities or indirectly as a result of improved public access (Reference 19). Alternatives F3, G2, and G3 have the greatest potential for impacts to archaeological and historic sites. Alternatives C3(a)/(b), C4, D1, and G4 are in areas with little archaeological potential. Once a final route is selected, historic and archaeological resources within the project's area of potential effect will be identified and evaluated in accordance with the requirements of 36 CFR 800.4.

#### **4.4.4 Visual Impacts**

The analysis of visual impacts resulting from the project alternatives indicate that, in general, the bridge alternatives—C3(a)/(b), C4, D1, and F3—would have a more substantial overall impact on the viewsheds throughout the project area than would the ferry alternatives (Reference 20). Those impacts would be most notable in proximity to the bridge structures. While bridge alternatives would, to varying degrees, represent new visual elements in most viewsheds, none of the alternatives introduces a man-made element to an otherwise pristine or natural setting.

#### **4.4.5 Traffic Impacts**

The traffic analysis (Reference 21) indicated that the required improvements related to the project are comparable for each of the alternatives. While all alternatives would require an improvement on Tongass Narrows at a bridge or ferry access intersection, only Alternative F3 would require an additional improvement (i.e., to Deermount Street).

#### **4.4.6 Hazardous Waste**

The investigation of hazardous waste sites (Reference 22) indicates that all of the alternatives could affect potential hazardous waste sites within the airport property. The airport property should be investigated further to characterize the potential for the presence of hazardous wastes in the soil, groundwater, surface water, and air, particularly in those areas where construction

could occur. The following properties on Revillagigedo Island are recommended for further investigation with respect to potential hazardous waste occurrences:

- The bank property and car dealership at the north and south corners, respectively, of the Tongass Avenue – Signal Road intersection (Alternatives C3[a] and [b]).
- The quarry site and associated construction staging area (Alternatives C4 and D1).
- The Pro Mech hangar on Peninsula Point (Alternative G2).
- The commercial/industrial areas proposed as ferry terminal sites for Alternatives G3 and G4.

#### ***4.4.7 Utilities Impacts***

Relocation of utilities would be required for construction of the bridge alternatives (C3[a]/[b], C4, D1, and F3), whereas the ferry alternatives (G2, G3, and G4) would not require utilities relocations (Reference 23). Future Development on Gravina Island and (for Alternative F3) Pennock Island would require provisions for water, sewer, electric, and telephone facilities. All of these systems have sufficient capacity to accommodate the expected increase in demand.

#### ***4.4.8 Construction Impacts***

All of the alternatives will require the use of staging areas for equipment and materials (Reference 24). Impacts to these areas are expected to be temporary. The land will be returned to its previous use when construction is finished and revegetated with native plants and soils as needed. In addition, land for right-of-way and for roadways, bridges, and terminals will need to be acquired. Any habitat or wetlands on this land will be lost, though the alternative alignments were selected to avoid impacts to wetlands and streams to the extent practicable.

Temporary construction impacts are expected to be none or negligible for all areas considered except for subsistence. Subsistence use will be adversely affected, but harvests are not expected to decline. Historic and archaeological sites are known or are likely to occur in areas traversed by Alternatives F3, G2, and G3. A detailed evaluation of historic and archaeological sites in accordance with 36 CFR 800.4 will be conducted after selection of the preferred alternative.

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3. Gravina Access Project Draft Bridge Structure Technical Memorandum. December 2001. Prepared for Alaska DOT&PF.
4. Ferry Terminal Draft Conceptual Design and Cost Estimates Memorandum to Roger Healy from Mark Dalton. October 2001.
5. Gravina Access Project Draft Design Criteria Technical Memorandum. October 2001. Prepared for Alaska DOT&PF.
6. Gravina Access Project Draft Monte Carlo Navigation Simulation Technical Memorandum. January 2002. Prepared for Alaska DOT&PF. Prepared by The Glosten Associates, Inc.
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10. Gravina Access Project Affected Environment Technical Memorandum. July 2000. Prepared for Alaska DOT&PF.
11. Relocation Impacts Memorandum to Roger Healy from Mark Dalton. August 2001.
12. Gravina Access Project Draft Social Environment Technical Memorandum. November 2001. Prepared for Alaska DOT&PF.
13. Gravina Access Project Draft Economic Impact Assessment. January 2002. Prepared for Alaska DOT&PF. Prepared by Northern Economics.
14. Gravina Access Project Draft Effects on Cruise Ship Operations. January 2002. Prepared for Alaska DOT&PF. Prepared by Northern Economics and Klugherz and Associates.
15. Gravina Access Project Draft Ketchikan Gateway Borough Economic Forecasts Technical Memorandum. September 2001. Prepared for Alaska DOT&PF. Prepared by Northern Economics.
16. Gravina Access Project Draft Traffic Projections Technical Memorandum. November 2001. Prepared for Alaska DOT&PF.
17. Gravina Access Project Draft Land Use Impacts Technical Memorandum. November 2001. Prepared for Alaska DOT&PF.
18. Gravina Access Project Draft Biology Report. October 2001. Prepared for Alaska DOT&PF.
19. Gravina Access Project Draft Archeological Reconnaissance Survey. November 2001. Prepared for Alaska DOT&PF. Prepared by Cultural Resource Consultants.
20. Gravina Access Project Draft Visual Impacts Assessment Technical Memorandum. November 2001. Prepared for Alaska DOT&PF.
21. Gravina Access Project Draft Traffic Assessment Technical Memorandum. December 2001. Prepared for Alaska DOT&PF.
22. Potential Hazardous Waste Sites Memorandum to Roger Healy from Mark Dalton. August 2001.
23. Gravina Access Project Draft Utilities Assessment Technical Memorandum. November 2001. Prepared for Alaska DOT&PF. Prepared by Carson Dorn, Inc.
24. Gravina Access Project Draft Construction Impacts Technical Memorandum. November 2001. Prepared for Alaska DOT&PF.

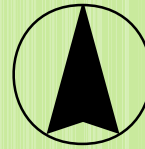
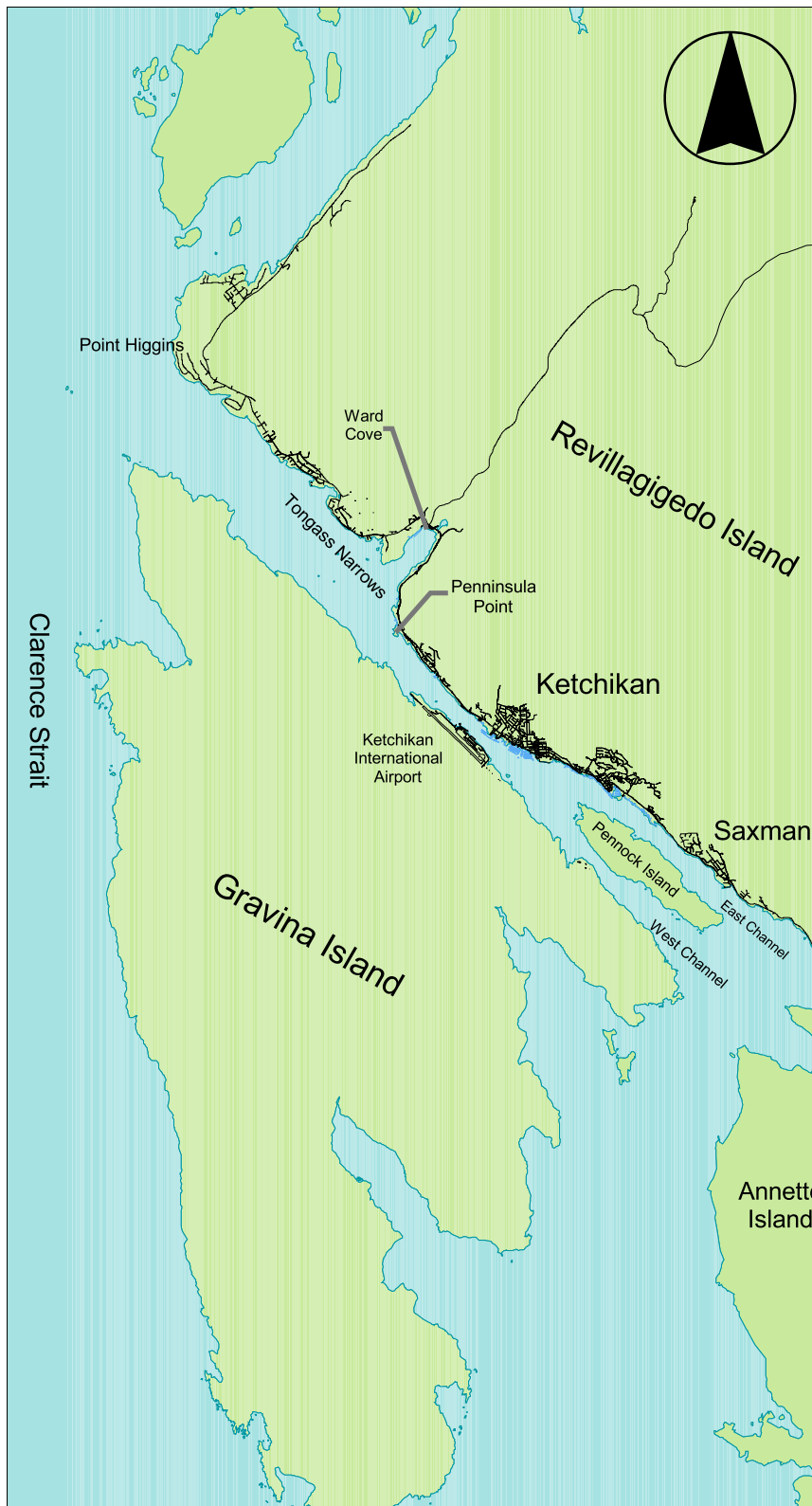
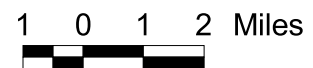
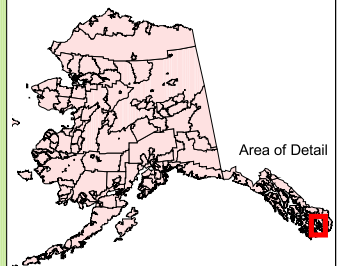


Figure 1  
Gravina Access  
Project Study Area:  
Vicinity Map

-  Roads
-  Water
-  Land





# GRAVINA ACCESS ALTERNATIVES



WARD  
COVE

REVILLAGIGEDO ISLAND

PENNOCK  
ISLAND

TONGASS

NARROWS

AIRPORT  
AV

GRAVINA ISLAND

## LEGEND:

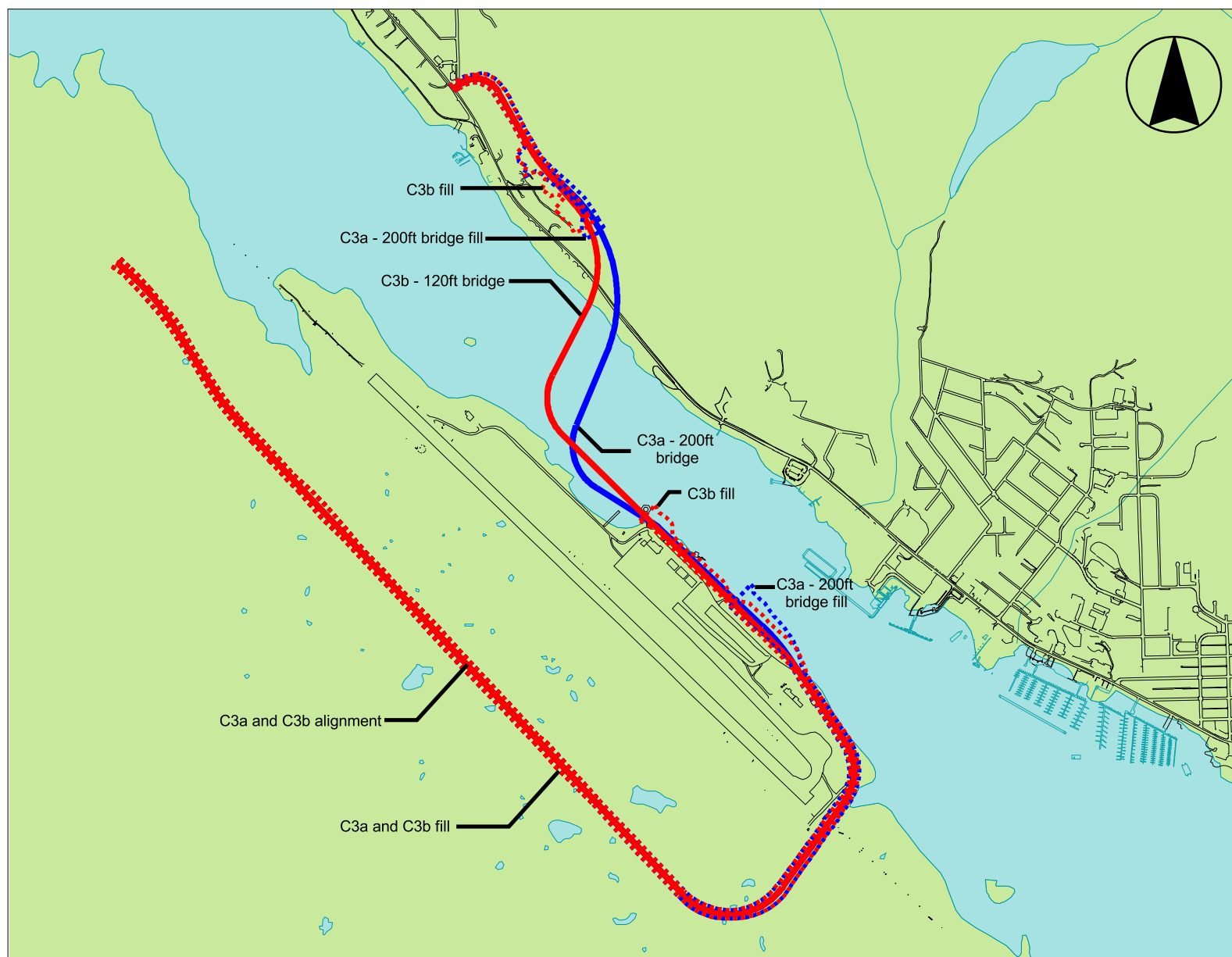
- ALTERNATIVE C3 (a) - 200'
- ALTERNATIVE C3 (b) - 120'
- ALTERNATIVE C4 - 200'
- ALTERNATIVE D - 120'
- ALTERNATIVE F3 - 200'
- - - FERRY ROUTE ALTERNATIVES G2, G3 & G4

STATE OF ALASKA  
DEPARTMENT OF TRANSPORTATION  
AND  
PUBLIC FACILITIES











## GRAVINA ACCESS PROJECT

DECEMBER 2001

Figure 3  
Gravina Access Project  
Study Area:  
Alternatives C3(a)/(b)



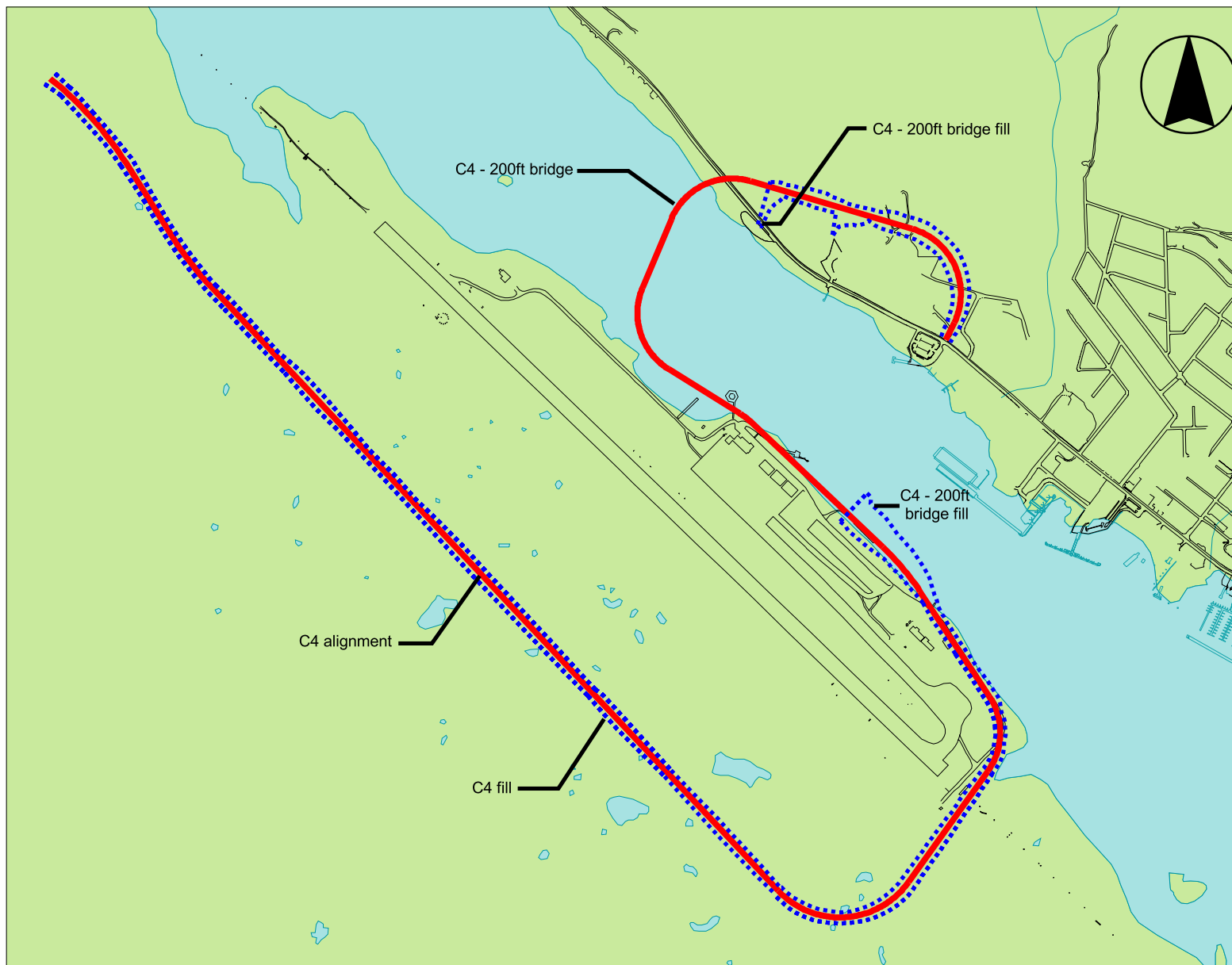
Alternatives









-  C3a - 200ft bridge
-  C3b
-  C3a - 200ft bridge fill
-  C3b fill
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.1 0 0.1 0.2 0.3 Miles



Figure 4  
Gravina Access Project  
Study Area:  
Alternative C4



-  Alternative C4
-  C4 - 200ft bridge fill
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.1 0 0.1 0.2 Miles


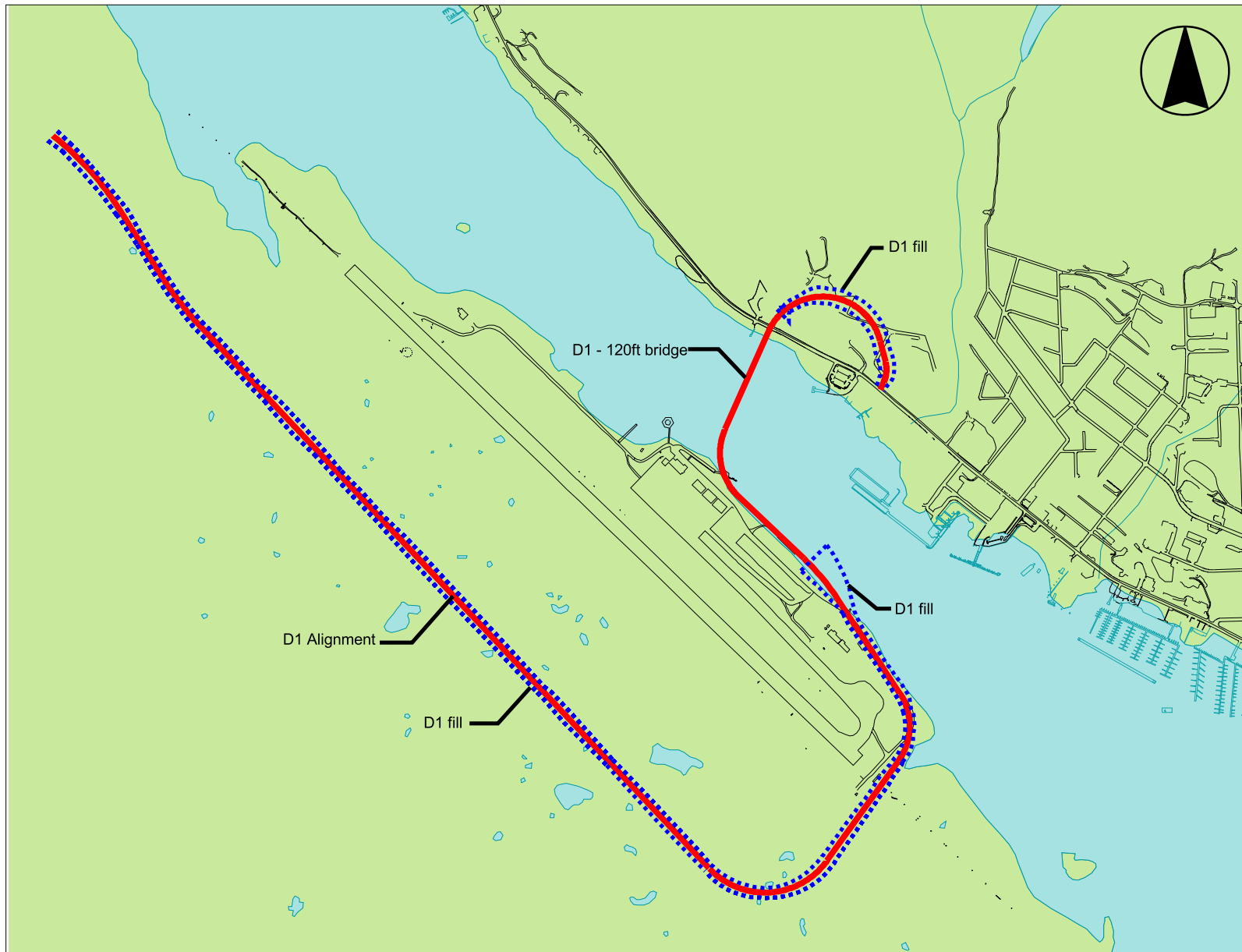











Figure 5  
Gravina Access Project  
Study Area:  
Alternative D1



-  Alternative D1
-  Alternative D1 Fill
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.1 0 0.1 0.2 Miles













Figure 6  
Gravina Access Project  
Study Area:  
Alternative F3



-  Alternative F3
-  Alternative F3 Fill
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.3 0 0.3 0.6 Miles















Figure 7  
Gravina Access Project  
Study Area:  
Alternative G2

-  Alternative G2
-  Alternative G2 Fill
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.2 0 0.2 0.4 Miles


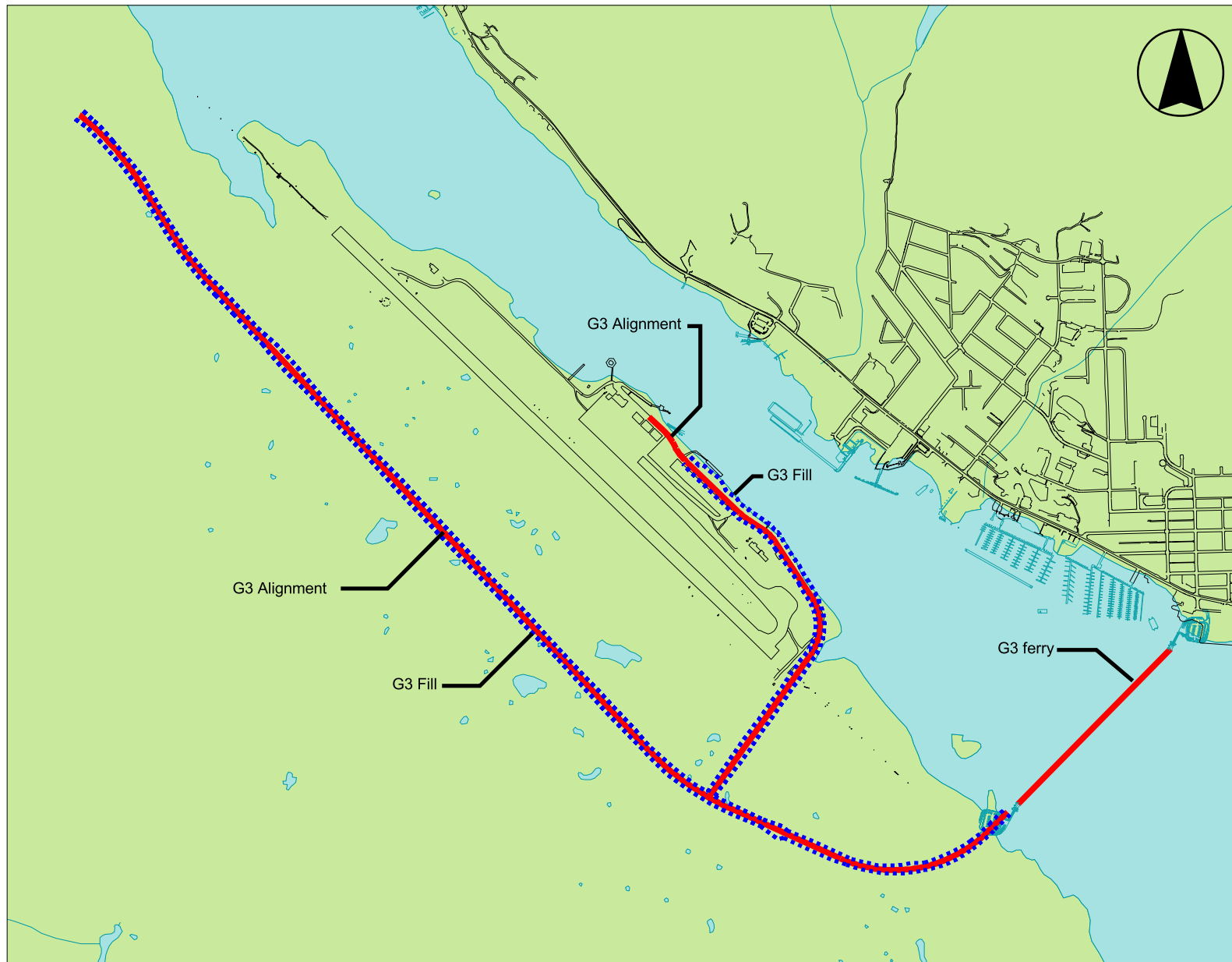








Figure 8  
Gravina Access Project  
Study Area:  
Alternative G3



-  Alternative G3
-  Alternative G3 Fill
-  Roads
-  Ferry Routes
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.1 0 0.1 0.2 0.3 Miles


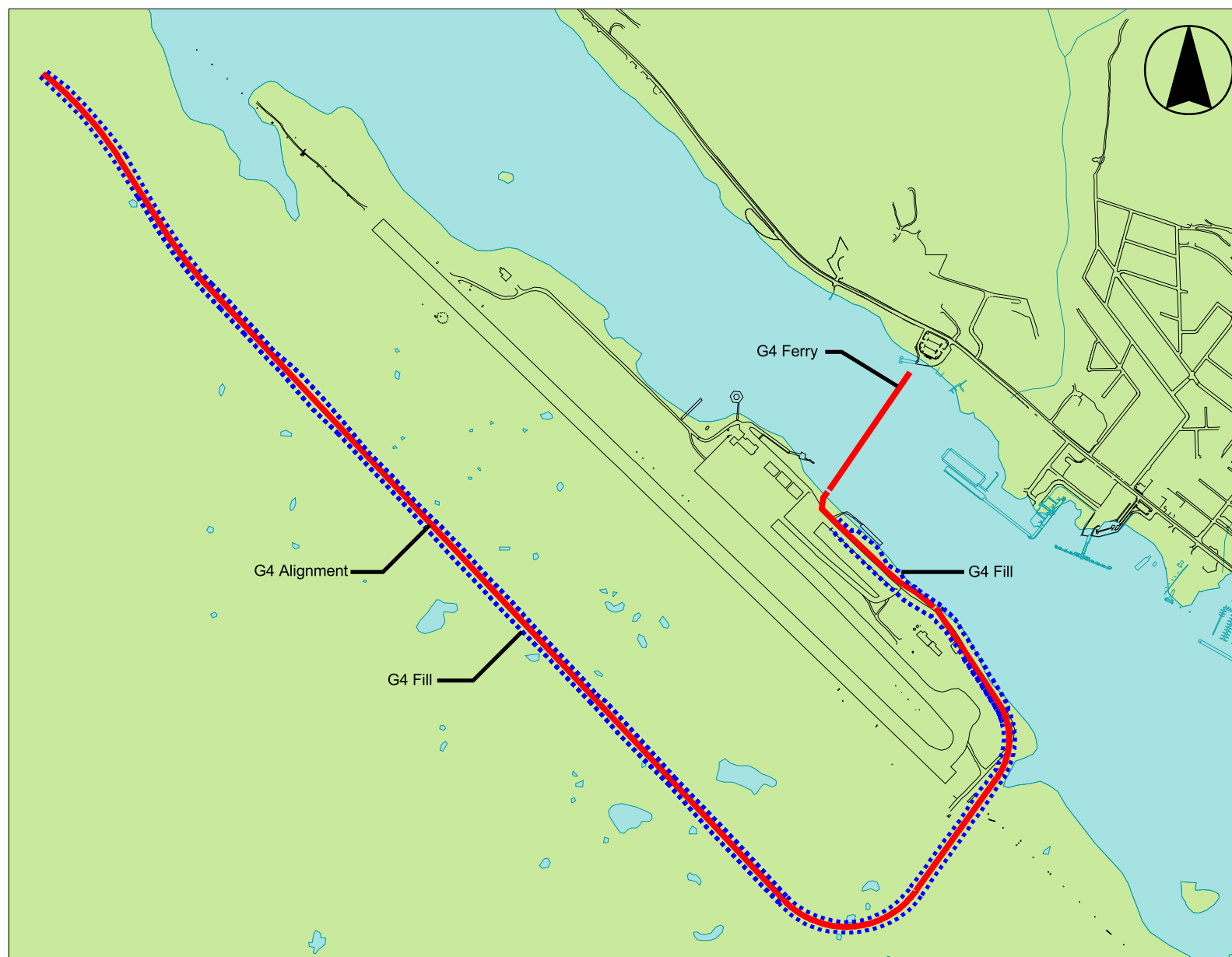










Figure 9  
Gravina Access Project  
Study Area:  
Alternative G4



-  Alternative G4
-  Roads
-  Docks
-  Airport Structures
-  Streams
-  Water Bodies
-  Land

0.1 0 0.1 0.2 Miles

